

CASE STUDY

Natural Gas Is the Natural Choice for Baltimore Gas & Electric's Service Vehicles



Baltimore Gas & Electric (BG&E) began experimenting with alternative-fuel vehicles around the turn of the last century when the first electric vehicles appeared. As a new century approaches, BG&E turns to compressed natural gas – another of its own products – to fuel its vehicles.

First Steps

Established in 1816, BG&E is the nation's oldest utility company. It provides electricity to about 1.1 million customers and natural gas to about 600,000 customers, all in the Baltimore metropolitan area. Its fleet of 2,840 vehicles is used to service and maintain utility systems. These service vehicles carry spare parts, store tools, and serve as workshops on wheels, and they are deployed throughout BG&E's service area.

The Clean Air Act of 1990 and the Energy Policy Act of 1992 motivated BG&E to start an alternative-fuel vehicle (AFV) program for its fleet. According to BG&E, AFVs cut costs and reduce pollution, and they're creating a new market for BG&E's products – natural gas and electricity.

Although BG&E participates in electric vehicle demonstrations and research, the limited availability and lower driving range of electric vehicles led the company to choose natural gas vehicles (NGVs) for its fleet. BG&E had been testing NGVs since the 1980s and began to introduce them into everyday use in 1991.

Two types of natural-gas fuels are available. Liquefied natural gas (LNG) is natural gas that has been condensed to a liquid, typically by cryogenically cooling to about -250°F. Compressed natural gas (CNG) is natural gas that has been

compressed to a pressure of 2,400-3,600 psi. BG&E chose CNG rather than LNG because

- No original equipment manufacturers (OEMs) offered LNG vehicles in 1991;
- CNG conversion technology was more developed, simpler, and less expensive than LNG technology; and
- BG&E produced only a small amount of LNG and could not support a larger market without expanding production, a difficult task in a heavily populated area.

Converting to CNG

BG&E began its fleet program in 1991 by converting six Chevrolet G20 3/4-ton cargo vans to natural gas fuel to evaluate the technology and equipment under daily working conditions. The vehicles had been purchased for regular fleet use, not specifically with conversion in mind. Four were converted to dual-fuel CNG/gasoline use, and two to dual-fuel LNG/gasoline. The NGVs performed as well as equivalent gasoline vehicles, indicating they could easily be integrated into the fleet.

Jeff Shimp, Supervisor, Facilities and Fleet Services, says, "The tests proved to us that we could implement NGVs in our fleet and survive."

Meanwhile, BG&E tested a prototype dedicated CNG van manufactured by Chrysler Corporation. The vehicle performed so well that BG&E ordered 95 for its fleet in 1992 and 71 more in 1994. BG&E has not converted many vehicles since OEM vehicles became available. Shimp prefers OEM vehicles because

- They are dedicated vehicles that run solely on CNG;
- Their engines are optimized for CNG;
- They have lower emissions; and
- Engineering, training, and warranty services are available through the manufacturer.

In-Use Performance

Technicians take their service vehicles home with them at the end of the day. In the morning, they log on to mobile computer terminals in their vehicles to

BG&E'S CURRENT AFV FLEET

Conversion Vehicles		
Dual-Fuel	Dedicated	OEM Vehicles
1986 Ford Bronco (1)	1988 Crown Victoria (1)	1991 Dodge B350 van (1)
1990 Oldsmobile 88 (1)	1990 Chevrolet vans (3)	1992 Dodge B350 van (95)
1993 Chevrolet van (1)	1991 Chevrolet Lumina (1)	1994 Dodge B350 van (71)
1993 Chevrolet step-van (1)	1991 Dodge van (1)	1996 Ford Crown Victoria (1)
Fork lift (1)	1992 Chevrolet Hi-Cube van (2)	
	1992 Chevrolet Suburban (1)	
	1992 Dodge Spirit (1)	
	1993 Dodge Grand Caravan (1)	
	1994 Chevrolet pickup (1)	

find out where their work assignments are, and they drive directly to the job site without going to a central facility.

When BG&E drivers are first assigned to drive NGVs, they view a training video that explains the natural gas system. The user education program includes talks on vehicle operation, testing results, and safety. Drivers are taught how to fuel the NGVs, and instructions are posted at the fuel dispensers. Shimp says: "It was a big task to train everybody when we first assigned these vans. Now, pretty much everybody has driven one. They contact us if they have any concerns."

Drivers were eager to try the new vehicles, especially as they were the first BG&E service vehicles that came with air conditioning! Their major concerns were the range of the vehicles (about 180 miles per tank on CNG compared with 230 miles on gasoline) and the need for more fueling stations. These factors required drivers to plan their workdays more carefully.

Stop-and-go driving and running the air conditioning results in a fuel efficiency of 10 mpg for both CNG and gasoline vans. To extend the driving range of the CNG vans, BG&E added an extra fuel cylinder to each vehicle for a total fuel capacity of 20 gasoline-gallon-equivalent. The extra cylinder is mounted between the work screen and the back of the seats, in an otherwise unused space, so that cargo capacity is not diminished.

The CNG vans are fueled at a network of seven BG&E-owned stations strategically located throughout the Baltimore area. Five of the stations are operated by BG&E, and two are operated by Crown Petroleum, a commercial fuel supplier.

Fleet Facts

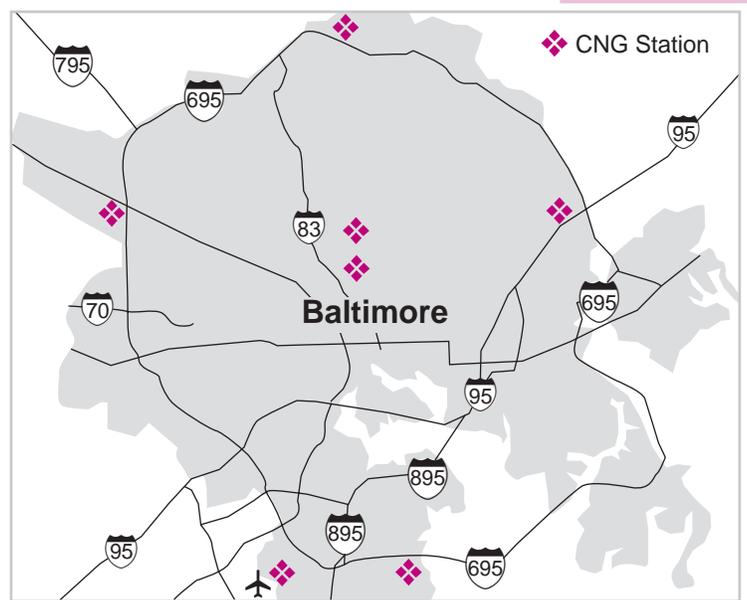
Fleet Type: Utility company

Fleet Size: 2,840 vehicles including 185 AFVs

Alternative Fuel: Compressed natural gas

Vehicles: Vans, service vehicles

Location: Baltimore, Maryland



Maintaining CNG Vehicles

BG&E has 86 mechanics on its staff, of which 50 have been certified by the National Institute for Automotive Service Excellence (ASE) to work on CNG vehicles. The voluntary ASE certification recognizes both work experience and results of a written test on installing and maintaining CNG equipment on vehicles. The mechanics are also OEM-certified to perform warranty work on the vehicles.

Shimp explains that working on OEM CNG vehicles is similar to working on



gasoline vehicles: the fuel delivery systems are similar, except that the CNG vehicles have a high-pressure regulator instead of a fuel pump and fuel cylinders instead of a gasoline tank. Maintaining a converted vehicle is more complex, however, because components are added to an existing system. Many of the conversions are bi-fuel vehicles and have two separate diagnostic systems that sometimes interfere with each other.

BG&E experienced a few system failures in the conversions and the early OEM vehicles. In conversions, failures tended to occur in the electronic computer valves and system controls. In the OEM vehicles, problems were more likely in injectors, regulators, or solenoid valves.

The reliability problems with conversions are being resolved gradually. Shimp warns: "In the conversion market, you really do have a hard time with warranties. It's easy for the manufacturer to say 'It's not my problem, it's the OEM's problem,' and vice versa. It can be difficult to make a case to recover the warranty dollars."

The few early OEM design problems have been eliminated in newer models. When BG&E has a problem with an

OEM vehicle, it goes directly to the manufacturer. Shimp explains: "We have a territory person for warranty. But for design problems, we go right to the manufacturer. In many cases, they will be happy to hear from us because information on problems in the field may not always get back to the engineering and support staff. We send failed components back to them, and they'll test them. Sometimes, they will re-engineer a component."

CNG Safety

"It's been our experience, and I think the industry's experience, that natural gas vehicles are very safe...safer than gasoline," claims Shimp. Two examples illustrate his point:

- A step-van converted by BG&E was involved in an accident in which it rolled over, but the fuel cylinder held and no CNG leaked.
- When one of BG&E's CNG vans experienced a problem in the differential gear, a towing company put a hook on its front end for towing. As the tow truck drove on the Baltimore Beltway, the complete differential gear assembly came apart, and the van was dragged on its fuel cylinder at 55 mph! And still no leaks!

BG&E's electric-utility technicians receive basic information on safe handling of natural gas. The natural-gas technicians work with this fuel daily, and Shimp mentions that they have no concerns regarding its safety as a vehicle fuel.

Cost Analysis

The first Chrysler CNG vans cost \$3,800 more than an equivalent gasoline van without the additional fuel tank and \$5,000 more with the extra tank. The cost differential between CNG and

gasoline vehicles has been reduced, and newer vehicles come with larger tanks so extra tanks are not necessary.

Retail prices for natural gas tend to be \$0.20 to \$0.30 less per gallon than gasoline, and internal pricing reduces BG&E's fuel cost even further.

Shimp expects CNG vans to have a life cycle of eight to nine years, depending on mileage, compared with about seven years for gasoline vehicles. He believes that the life expectancy for an NGV is longer because CNG burns more cleanly than gasoline.

To determine whether its investment is paying off, BG&E performs a life-cycle cost analysis every year or two. A truly meaningful cost analysis is difficult, however, because most of the components are still covered under warranties and the operating costs appear lower than they really are. However, Mike Burton, Manager, Facilities and Fleet Services, has little doubt the investment will pay off: "If you get an extra year or two on the life of the vehicle, you're going to recoup the initial investment. It's penny wise and pound foolish to think it doesn't work."

The CNG vehicles seem to have more than just financial benefits. In state-required emissions tests, BG&E's OEM dedicated CNG vehicles showed about one-sixth of the emissions of gasoline vehicles – close to federal ultra-low emission vehicle standards. As Burton puts it: "We believe that it offers a value that is hard to place a price on, but we realize those benefits [cleaner air, lower social costs]."

By the Numbers

Fuel Cost: \$0.95/gasoline gallon equivalent for CNG, \$1.25/gallon for gasoline

CNG Fuel Tank Capacity: 20 gallons

Fuel Economy: 10 mpg for both CNG and gasoline

Range: 180-200 miles on CNG, 230 miles on gasoline

Spreading the Word

BG&E encourages other fleet managers to consider NGVs. About 40 other fleets use the CNG stations to fuel 416 NGVs in the Baltimore area. These BG&E customers include federal, state, and city government fleets as well as private fleets. BG&E has also installed on-site CNG facilities for several government fleets located near Baltimore. The utility is now working on "universal access" to fueling stations so that NGVs can be fueled at CNG stations around the state of Maryland, and eventually nationwide, through the use of fleet cards. This effort will extend the useful range of fleet NGVs by increasing access to fuel.





BG&E also promotes AFVs through its public information activities. It gives presentations to trade organizations, customers, and other fleets and at auto shows and high schools. The utility also participates in the U.S. Department of Energy's Clean Cities Program, which encourages the use of AFVs.

In addition, BG&E has trained 1,500 local firefighters on NGV safety. Maryland State Police officers have also been trained on NGV awareness and safety. BG&E is also working to make NGVs eligible for state safety inspections for vehicle resale.

Looking to the Future

"In 10 years, CNG vehicles will be a much bigger success story than they are today. These vehicles are very clean to

operate, much safer than gasoline, and cost-effective," claims Burton. He believes fleet managers will realize that the use of natural gas as a vehicle fuel is inevitable when several conditions occur: lower fuel cylinder cost, equal pricing of CNG and gasoline vehicles, greater availability of OEM CNG vehicles, and expansion of the fueling infrastructure.

Shimp advises others to start out slowly and have realistic expectations for cost and performance: "For an average fleet, the best thing to do is to contact a utility company. Talk to BG&E; we've been down the road and we know what the pitfalls and perils are, what works and what does not work. We can help them get started."

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This brochure has been reviewed by representatives of vehicle manufacturers, fuel providers, fleet operators, and federal and state governments.

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Disclaimer

This case study is intended only to illustrate approaches that organizations could use in adopting AFVs in their fleets. The data cited here, although real experience for the fleet discussed in this case study, may not be replicated for other fleets. For more comprehensive information on the performance of AFVs and other related topics, please call (800/423-1363) or e-mail (hotline@afdc.nrel.gov) the National Alternative Fuels Hotline. To learn more about DOE's role in alternative-fuel vehicle research, visit the Alternative Fuels Data Center on the World Wide Web at <http://www.afdc.doe.gov>.

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